Discoveries in Science and Important Facts.

SCIENCE AND INDUSTRY.

SOME LATE ACHIEVEMENTS AND NEW DISCOVERIES.

Wonderful Process of Making Tin Cans — International Geological Congress to Be Held at St. Petersburg.

In view of the fact that prominent fruiterers say that this will be one of the biggest canning seasons on record, the wonderful process of tin can making takes on added interest. Tin cans are made by machinery. Over 400,000,000 a year are produced in this country. Out of the 7,000,000 boxes of tin plate (120 sheets to the box) used yearly only 2,000,000 boxes go for general use. The remaining 5,000,000 boxes of tin (600,000,000 sheets) are made into cans. Common fruit cans represent two-thirds of the entire product. Assuming six inches as the average height of a can, some idea of the enormity of this product may be had when it is pointed out that if the cans were to be placed end to end the latter would be 37,878 miles in length—long enough to reach one and one-half times around the earth.

FOUR HUNDRED THOUSAND CANS

Twenty years ago a fruit can factory consisted of several dozen men and as many boy helpers, who made the cans all by hand, cutting them out with shears, passing the sides through a ringer to roll them in shape. The bottoms and covers were shaped by means of dies, and the parts all put together and soldered by hand. Naturally when buying canned goods in those days a few cents went to pay for the can. With 20 men and their helpers the most that could be produced in those days was 16,000 a day. The same number of employees, most of them boys, are now able, by means of automatic machinery, to turn out over 200,000 a day. There are now in existence in New York, Chicago and Baltimore large plants employing machines, having a daily capacity of 400,000. The production has increased rapidly year by year as new machines have been invented, until now it is only necessary to insert quantities of tin sheets into one part of the machine to have them automatically pass through all the stages of manufacture and drop out at the other end in the shape of completely formed cans.

The improved machine of today is a combination of eight or ten machines. The tin sheets, cut exactly the same size, are loaded in a machine that reminds one of a printing press. This machine is a self feeding, rolling and morticing machine, taking one sheet at a time, looping over a narrow margin on each edge of the sheet, hooking these looped edges together, and finally clinching tightly the joint thus made. This process completes the body of the cans, which drop upon an endless belting and are carried to the next point of development. As it passes along the seam faces downward and runs through a solder well, which fills the joint with lead. The surface of the joint is rubbed off smooth.

The bodies of the cans now automatically pass into the horizontal apertures of a massive wheel, which revolves and stops like the cylinder of a pistol. Two boys, seated above this wheel, have all they can do to keep two upright slides filled with heads and bottoms for the cans. One by one, these fall in place, and are forced on either end of the can bodies by dies. The wheel revolves as each is finished, and they are thrown out and carried along to the next machine.

A CONTINUOUS LINE.

The can, though now practically completed, runs into a long machine, consisting of belts and chains, the line of cans passing up on one side at an angle of 45 degrees around at the further end and back again. This is the automatic top and bottom solderer. An endless chain, which moves along faster than the cans, rests on top of them, so that they are rolled as they advance. The cans are tilted at an angle, so that the bottom and top edges or joints are, in turn, rolled around in a long solder well at the lower point of the angle. The tops are soldered on one side of the machine, the bottoms on the other. An elevator now carries them to a burnisher, and thence to the big tester, where a pressure of 35 pounds to the square inch is exerted upon the can, to insure its strength and prove it water tight.

This system of machines occupies an enormous space, and a continuous line of bright cans is seen moving rapidly in all directions, as a plant usually consists of a number of these complex systems on a floor. Slightly different machines are used for different styles of cans—tomato and corn cans, baking powder, condensed milk, fruit, spices, druggists' materials, etc.—some machines lapping joints over a second time, so that they are water tight without being soldered.

It is a mistaken idea that there is no further use for the tin can when thrown out with the rubbish. Smelting companies keep wagons employed constantly, and many individuals make a business of gathering old tin cans by the wagon load at the city dumps and around the suburbs, receiving as high as $3.50 a load.

OLD CANS VALUABLE.

At the smelters they are dumped on a grate, where the flames from burning shavings melt off the tin and lead. Some of the remaining iron pieces are frequently sold to trunk manufacturers for use in binding the frames of trunks, the rough surface of the metal holding the paint well. Generally, however, it is melted up over very hot fires and molded into various castings. Most of these factories manufacture sash weights, weights for elevators, etc., from the time and other common forms of castings, although there is now a method by which the iron from the old tins can be refined and used for first-class castings.

INTERNATIONAL GEOLOGY.

Interesting Features of the Seventh International Congress.

The seventh international geological congress, which convenes in St. Petersburg tomorrow, will in many ways be the most marked scientific congress that has ever been called together. Not so much, perhaps, by reason of the large number of eminent men who are likely to partake in its deliberations, as through the far reaching liberality of the Russian government.

Not before in the history of associations of this kind has a like spirit governed their formation and execution, and it is safe to predict that many years will elapse before there will be a return to it. Although not generally so known, Russia has for many years taken an advanced position in the development of the natural and physical sciences, and many of her men stand second to none as original investigators in the departments of astronomy, physics, physiology, zoology and embryology.

BIGGEST SCIENTIFIC BUREAU.

The scientific bureau of the world which has the most extended scope is that of the geological survey of the Russian empire, a field of labor which covers not alone 2,000,000 square miles of continental Europe, but the 5,000,000 or more that are covered by the Russian possessions in Asia. Thus it is that a territorial survey carries its work over a region twice as large as that which is controlled by the United States geological survey, and it is in conformity with this broad line of investigation that the lines of the congress have themselves been organized. All delegates to the convention have been accorded by the Russian government a free pass on the railroads of the empire for a period of three months, starting from the frontier and returning to any point of it—a concession which has reaped its reward in the unprecedentedly large attendance which has been assured the congress. But of far greater significance to the interests of geology, and to the proper understanding of the more important problems that are associated with the geology of the Russian empire, and which have a more than general value for geologists the world over, are the extended excursions which have been organized under the auspices of the bureau of direction, aided by the efforts of the department of the interior. One of these covers the north of Russia and Finland, a second traverses the Ural mountains into the plains of Siberia, and a third takes the route of the Volga to the Caspian, the traverse of the Caucasus into Trans-Cau-casia and the passage of the Black sea to the Crimea. The extent and importance of these excursions may be estimated from the magnitude of the official guide book which has been prepared for their illustration, a work collaborated in 24 parts and containing nearly 700 pages, beside a wealth of maps and illustrations. The guide book is, in fact, a manual of the geology of a large part of the Russian empire, and is one of the most thorough and explicit works of the kind that have ever been published for any country.

TOPICS TO BE DISCUSSED.

The topics of special importance that are to be discussed at the congress are those pertaining to unification of the science of geology—the effort to introduce for the world at large a system of common classification and terminology which, if successfully reached, will be a service rendered for which every geologist, whether taken from the ranks of the professional or from the laymen, ought to be thankful. Furthermore, the effort will be made to halt the modern tendency to increase the vocabulary of the science by adding new names to almose every phase of nature that appears in a given region—a condition which, if unchecked, would necessitate the free use of a lexicon, even by the professional gologist, for the proper understanding of almost every geological memoir. This blow to word-making or word-coining might be advantageously followed up in the construction of the languages of the related sciences, and it is to be hoped that at some not distant congress of zoologists and botanists, this topic, so important in its bewildering effect upon the student, will be taken up in the spirit and direction which are a part of the programme of the international congress of geologists.

HOW TIN CANS ARE MADE.

TONS OF DEADLY POISON.

ARSENIC GATHERED UP BY THE ROADSIDE IN CORNWALL.

An Arsenic King and His Strange Business—Is Really a White Soot, Resulting From the Burning of Mundic.

By R. H. SHERRARD.

If Africa can boast a diamond king and America a silver king, England has its arsenic king, for there lives in Cornwall the representative of a company of manufacturers who at times has all the arsenic in the world, or most of it, in his hands. Not many months ago this gentleman held £60,000 worth of the crystalline stuff. England has practically the world's monopoly of arsenic, and England in this case means Devon and Cornwall.

GLEANERS OF POISON.

A year or two ago there were in Cornwall places which were the most desolate to look at that one could imagine. It was as if here and there gigantic monsters had wantonly devastated the country. All around these monstrous rubbish heaps was silence. The cottages were deserted, the buildings had fallen in. Nobody ever came near. There were the sites of abandoned tin mines. Of late, however, there has been a change. On the mounds have appeared men, women and children, peering, groping, picking, piling up. To look at them, one would say, gleaners at work. These men and women are gleaning. Not, indeed, for the yellow ears which give bread, but for the white stones which give poison. They are searching the burrows for white mundic, technically called mineral mispickel, or arsenical pyrites. In former days this mispickel went to the rubbish heap. Now it is a valuable product. The gleaners are searching for arsenic, that wickedest and most infamous of mineral poison.

The word arsenic is apt to fill the ordinary mind with gloomy visions. To the chemist, to the industrial and to the husbandman, however, the word has a happier sound. In the hands of Fowler, it became a medicine which has restored vigor to the blood and color to the cheeks of thousands of sufferers. It is also the active principle in sheep dip, and a prominent manufacturer whose name is known all over the British empire, uses over 1,000 tons a year. It is largely used in aniline dyes. It enters into the composition of certain kinds of glass, is mixed with lead for making shot, and in the form of paris green, it triumphed over the pest that was the phylloxera of the potato. In the Calstock district in Devonshire, the various mines—the Devon Great Counsul's, Holmbush, Okel, Tor, Coomberworks, Gawton and Westlake—until recently have been producing about 600 tons of arsenic a month. Arsenic is now worth £23 a ton. A few years ago it was worth but £12. The rise in the price is owing to the failure in some of the mines.

WHAT ARSENIC REALLY IS.

Arsenic is soot, white soot. Refined arsenic is the soot of soot—that is to say, it is the soot of crude arsenic, which is the soot of the ores or of mundic. The stones or ores as they come from the mines are crushed by stamps, mainly driven by water power, to the consistence of sand or gravel. Mundic is usually less finely crushed than the ores which are to be treated for tin. This sand or gravel is then shoveled into a kiln or furnace.

"I can show you the whole process of arsenic getting in a few minutes," said Mr. William Thomas of the Camborne School of Mines. "It is very simple." He produced a piece of white mundic, which we had picked up on one of the burrows at Dolcoath mine, broke off a small piece and pounded this into powder with a hammer. He then took a glass tube, which was bent at an angle of 60 degrees. "That part which is horizontal," he said, "represents the kiln. This gas jet"—we were in the laboratory of the Camborne School of Mines—"represents the furnace, and the part of the tube which slopes upward represents the condensing chambers."

He then loaded the lower part of the tube with some of the crushed mundic and held the tube over the flame of the gas. Almost immediately a bright yellow cloud flew up, staining the tube yellow.

"There goes the sulphur," said Mr. Thomas. This was followed by white smoke. "That is the arsenic," he said.

As rapidly as it volatilizes, so rapidly does it condense. The arsenic fumes begin to deposit their soot as soon as they escape from the great heat of the furnace. There is crude arsenic. This was to be seen by this experiment also. The white smoke escaping from the tube deposited a grayish film on the interior of the glass, which came away in powder when the tube was tapped against the palm of the hand.

"That is crude arsenic," said Mr. Thomas. "To obtain refined arsenic, the arsenic of commerce, all you would have to do would be to roast that powder again. The second roasting would free it from any carbon or other substances which it may contain."

TERRIBLE IN ITS SIMPLICITY.

The manufacture of this poison is indeed terrible in its simplicity. One wet afternoon I had taken refuge in a Cornish cottage, where I fell in with a gentleman who is largely interested in this industry.

"It is the simplest thing in the world," he said. "Look, here is a piece of arsenical stone," and he produced a glittering pebble. "Well, with nothing but that stone, the kitchen fire, and that shovel there, I can produce enough arsenic to kill every man, woman and child in this cottage within a few minutes." So he put his piece of white mundic in the fire, and held the shovel over it, so that the fumes should strike it as they rose, and there, true enough, after a few minutes, was a deposit which, when scraped, came away in the form of grayish powder. "That's arsenic," he said; "would you like to taste it?"

Arsenic, then, is the soot which is deposited by the fumes which rise from the roasting of arsenical ores. If these fumes were allowed to escape up a long chimney direct from the furnace, that chimney would soon become choked with white soot; but much would escape with the rest, and wreak devastation abroad. Arsenic fumes are very dangerous to vegetation, as well as to life, and accordingly, even when this soot had little or no commercial value, care was taken by the manufacturers to avoid the penalties of the alkali and other acts, to allow as little arsenic as possible to escape with the smoke from their furnaces. The smoke from the calciners is accordingly allowed to escape only after it has deposited every atom—as far as this is possible—of its arsenic soot. To produce this effect it passes through numerous chambers before it reaches the chimney through which it issues forth into the open air.

THREE HUNDRED TONS.

The number of these chambers varies, as does also their length. Sometimes they extend over 1,000 feet. The series of chambers forms one long zig-zag passage, broken at intervals by a wall extending almost its whole width, starting now from one side, now from the other. Each chamber is from five feet to five and a half feet high, and from three to four feet wide. Entrance is obtained into the chamber—for the purpose of clearing, out the crude arsenic or soot—through an opening in the wall, which is closed up with an iron plate carefully plastered over around the edges. Arsenic has a great affinity for oxygen, so that the slightest crack in the walls will serve for leakage. Here and there along a series of flues one sees little jets of escaping fumes, where the arsenic as they say in the district—is "smeeching." In this way, of course, a considerable quantity is lost. Thus in prospecting for lost arsenic in the flues of Okel Tor there were discovered in various cracks and crannies upward of 90 tons of the precious soot, and afterward a further 300 tons were dug up from under the floors of the chambers.

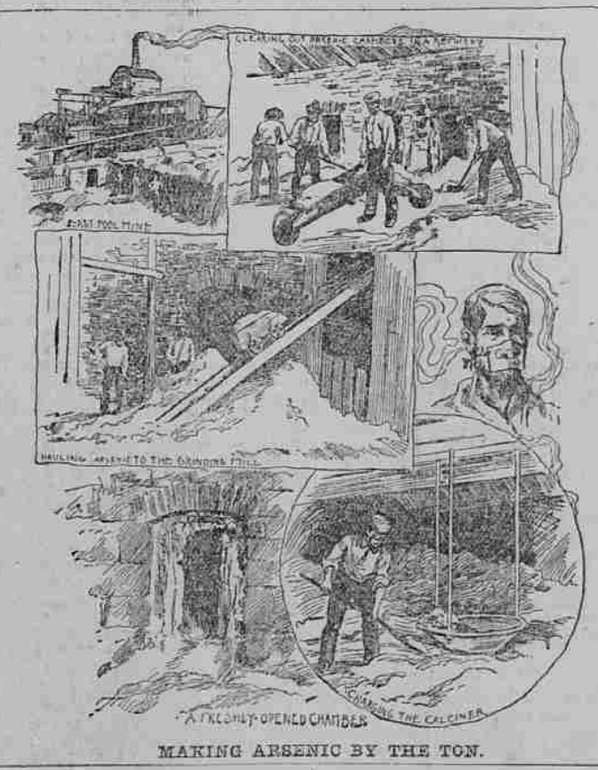
The chambers are opened at irregular periods. The crude arsenic is taken out by the shovel full and heaped up in a shed. At one mine I saw a heap of the bluish white soot. "There's enough arsenic there," said my guide, "to poison a wacle city." The bluish that which I noticed proceeded from the carbon and other extraneous matter, but this heap contained at least 70 per cent of pure arsenic, and was worth as it stood from £17 to £18 the ton.

THE PROCESS OF MANUFACTURE.

The crude arsenic has to be refined, so as to eliminate the flue dust, etc. The refining is practically a repetition of the roasting. From the furnaces a hot flue of brick work, generally about 100 feet long, leads to a series of zig zag "kitchens" or chambers. In the hot flue, the carbon, fine dust and other extraneous matter, deposit, while in the zig zag chambers what is practically pure arsenious anhydride condenses from the fumes. The arsenic is then taken to the milling room, where, with an ordinary flour mill, it is ground into fine powder and discharged direct into barrels, in which, by an ingenious automatic contrivance, it is tightly packed.

The men who attend in the milling room wear "muzzles," and are otherwise protected against the dust. The manufacturer of arsenic is not attended with danger, where ordinary precautions of cleanliness are observed by the workers. The arsenic worker, more than other men, should keep cool. Perspiration would open his pores and facilitate the entrance of the irritating arsenic dust to his skin. He must not wash in hot water for the same reason. One hears little or nothing of any serious injuries occurring to the workers. There was one fatality recently, and that was only indirectly connected with the arsenic manufacture. A little girl, who was carrying dinner to her father at the East Pool works, fell into one of the flues, the arsenic having corroded an iron plate on which she had imprudently ventured, and she was drawn out covered with the poisonous dust, from the effects of which she died a few hours later.

Nor does one hear of any ill use being made of the dangerous products by those engaged in its manufacture. I made many inquiries, and could only hear of one case, where a love lorn maiden dosed herself with an ounce of the soot, an over dose, which, as usual with poisons, was its own antidote. I also heard that three barrels out of the consignment of crude arsenic, shipped from Portugal, where some arsenic mining has recently been started by an English company, to a refinery at Bristol, were found to contain sand. One can only wonder what use the Portuguese miners who stole it mean to make of their plunder.



MAKING ARSENIC BY THE TON.

A CITY UNDER THE GROUND.

STRANGE THINGS BENEATH THE SURFACE.

Vaults, Subways, Sewers and Pipes Full of Human Interest—50,000 Miles of Telephone Wires—How Telephone Breaks Are Located—Tunnels Beneath the Sidewalks for Which Rent Is Paid.

Work was begun a few days ago on the underground system of pneumatic tubes which is to convey mail matter between the New York and Brooklyn postoffices. Thus another network of pipes and conduits will be added to the great maze which already underlies the streets of the metropolis. This is a side of modern urban development which is little appreciated. Ten years ago the underground city meant nothing more than a few sewer pipes, gas and water mains. Now it is made up of a labyrinth of pipes and passages, vaults and store rooms, where telephone, telegraph, electric light wires and a hundred other devices are hidden away.

THE LID OF A GREAT CITY.

Could one take off the lid, so to speak, of a great city the sight thereby revealed would be to most persons a surprising one. The bewildering maze of conduits, mains, pipes and tubes of every size and running in all directions is not attractive to the eye, but it forms a most instructive object lesson on the utilitarian luxury of twentieth century existence. Take lower Broadway, New York, as an example that may be nearly duplicated in the most crowded part of any other great city. The central portion of the street is taken up by the cables running in opposite directions in their iron vaulted passages. On either side of these are the subways, one containing telephone and telegraph wires, the other burglar alarm, electric light, and power wires and others of high tension. Further down and nearer the curb are the water mains and sewers, one on either side, and these are closely flanked by the vaults which run out as far as the sidewalk extends, and in many cases even further. The interstices are filled with gas mains, steam pipes and other conduits of small size. So closely do they lie that there is scarcely a foot of free soil within the limits of the street, and it seems beyond possibility to squeeze in another three inch pipe. Here beneath the thousands of feet that hurry hither and thither all day long pass the messages that control the operations of the great marts, the power that turns the wheels of modern business, the news that you will read in tomorrow's paper; here is concealed much of the mechanism on which depend the outward and visible glories of the modern metropolis, with its lofty buildings and magnificent proportions.

Nor is the underground city lacking in the attractive element of human activity. Beneath the echoing streets of the modern city hundreds of men are daily engaged in earning their living and although their work attracts little attention it is of the greatest importance to the health and convenience of their fellows on the surface. Take the work of cleaning the sewers for example. To speak of sewer cleaning may seem a paradoxical combination of words, but it is a fact that in the up-to-date city the sewers are kept even more neat than the streets above, and are well worth a visit if one goes prepared.

AT WORK IN THE SEWERS.

Entering from a convenient man hole one is at first overcome by the darkness. After a while, however, the eyes become accustomed to the deep gloom. Here and there are odd looking figures clad in rubber from the feet up, squatting in the passage way. One hand of each figure wields a long broom with which the walls are brushed, while the other carries a scoop to convey the accumulations from the bottom of the stream to a big wooden bucket. When the bucket is full it is dragged back to the nearest opening, hoisted to the surface and hauled away in carts. It is the hardest kind of labor and uses up the workmen rapidly, but nothing has yet been devised to take its place. The laborers usually work in gangs of three each, half a day in and half a day out, for a man could not work all day in the cramped position that he is compelled to assume under ground. Many attempts have been made to build machines that will do this work, but they have all proved to be failures when put to practical test, and the tons upon tons of accumulation that are removed every year are all taken out by hand. Strange things these workers come across sometimes. Now it is a child's toy lost in play, again a coin carelessly dropped by some passer by in the street above, at another time a watch thrown away by a sneak thief in his flight, and occasionally the evidence of a still darker crime.

One of the most interesting portions of the under ground town consists of the subways in which the electric wires are conveyed beneath the ground. These are among the newest members of the under ground community. It is scarcely five years since a beginning was made in removing the network of over head wires that stretched above all our great cities, and yet in many of them this maze of millions of miles of wire has all disappeared, although the work that it did is carried on as well as ever.

CLEANING WITH COMPRESSED AIR.

The task of keeping clean the iron pipe passages known as the subways has been greatly simplified by the introduction of compressed air in the form known as the pneumatic blower. This blower drives a strong current of air through the pipes and so prevents accumulations on their walls. The great danger in the management of electric subways has always been from explosions of gas. There were many accidents of this kind in which workmen were killed or injured, and it seemed impossible to prevent them, as the gas mains are always in a leaky condition, and the atmospheric pressure being less within the subways than on the outside it was impossible to keep the gas out. The pneumatic blower remedies this trouble by increasing the pressure until it is slightly above that on the outside.

In this connection it may be noted that compressed air is rapidly assuming a foremost place in the activities of the under ground city. In addition to transporting mail, cleaning pipes and keeping conduits free from gas, it has been found available for certain kinds of power work such as drilling and excavating. Compressed air can be transmitted through buried pipes without greater loss than attends the distribution of electricity, and already it is recognized as an important rival to the "subtle fluid."

By far the greatest length of wire that extends below city streets is used in the telephone service. Fifty thousand miles of wire is a great deal when one comes to think of it. Seventeen thousand separate wires leave the great Cortlandt street exchange in New York and are carried throughout the city in these labyrinthic passages, and yet if a break occurs in any part of this 50,000 miles it is not necessary to tear up the whole line or any part of it to determine where the trouble lies. Perhaps the break occurs late at night and is due to a fire. The operator in the exchange finds that one line is not working. By calling up various stations and cuting in a loop, he can locate the break as between certain stations. The size of the wire is known, and by obtaining a "ground," that is, by making an earth connection and calculating this relatively with size of the wire, the seat of the trouble is located within a few feet. Meanwhile the superintendent of construction is called up by telephone, and, summoning the men in the repair squad by telephone, in 20 minutes or an hour the break is repaired, and the line is in working order again.

VAULTS BENEATH STREETS.

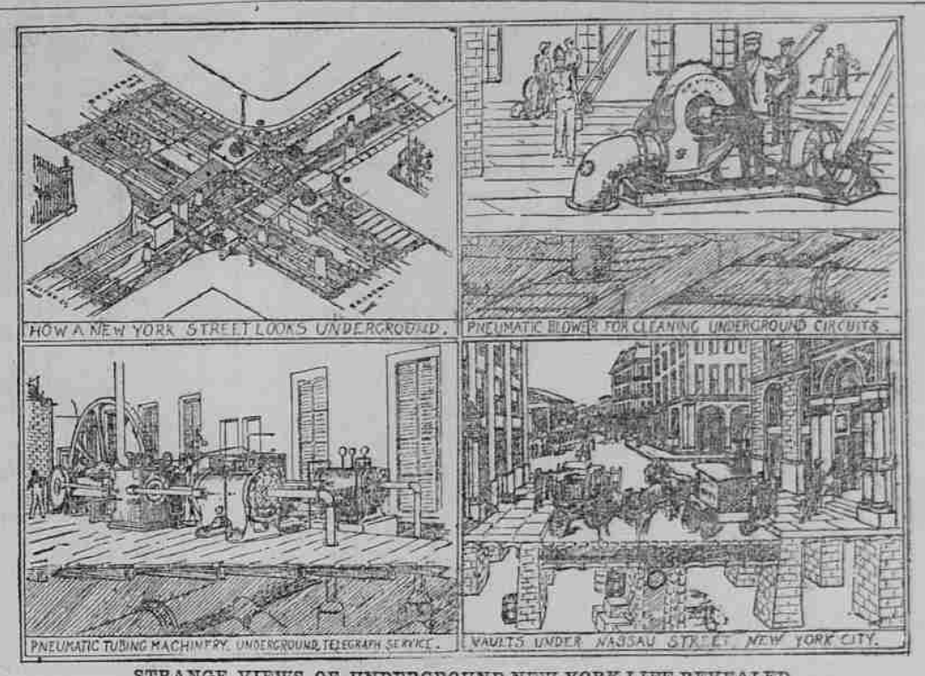
At present the vaults beneath the streets, which are variously used as store rooms, engine rooms or shops, are kept within limits, but the older portion of the city is still honey combed with subterranean passages. Two of the largest buildings in New York face each other across Nassau street, where it emerges into Printing House square. The American Tract society's building is 23 stories high and the New York Times building has 13 stories. Between them the street looks like a tunnel, but it is really only the cover for still deeper passages. The vaults beneath the Times building extend exactly to the middle of the street, while the vault on the opposite side extends to within a foot of it. It may give one a nervous feeling to think that there is less than a foot of solid soil beneath the thousands that throng Nassau street every day, but in reality there is no danger so long as the vaults are kept in repair. At the intersection of Reade and Duane streets there is a little restaurant entirely below the street where men eat their luncheon every day in calm unconcern of the fact that the heavy trucks of the manufacturing district are rumbling back and forth above their heads. There are similar cases in many places in lower New York and thousands of dollars of coin and treasure are buried in safe deposit vaults some of the chambers in which will extend well out beneath the streets.

Besides those that fulfill a useful purpose at the present day there are other deserted and cobwebbed vaults that tell an interesting story of forgotten ambitions and abandoned schemes. For instance, below Broadway in New York, between Warren and Murray streets, within a stone's throw of the city hall, is buried an under ground railroad project advanced a quarter of a century ago, and killed by the financial panic of 1873. A tunnel still connects these two streets and in it lies rotting the first car that was built to run on the buried road. The matter is of curious interest now that an underground rapid transit system is being planned for the metropolis. Between Elm and Mulberry streets in the once notorious Five Points district, is another ancient and well-nigh forgotten passage way that has aided many a criminal to give the slip to the officers of the law.

MODERN CAVE DWELLERS.

Though the modern under ground city is already so great in extent and employs so great an amount of human activity, it is more than possible that it is still only in its infancy. In this connection an interesting suggestion comes from General W. F. Soovsmith, the well known building engineer. He says that with the increase in the erection of structures of immense height on narrow plots of ground it will be found profitable to remove not only a large part of the soil beneath them as at present in sinking foundations, but all the natural earth that exists between the surface and the rock foundation, in some cases 50 or 60 feet below. He points out that when neatly tiled and well lighted by electricity those under ground rooms would answer nicely for storage chambers, barber shops and many kinds of offices that now occupy valuable spaces above ground. And so it seems more than likely that in the 20th century city the ancient cave dwellers will be out done by the occupants of our great office buildings, and that in time the sky scraper will extend as far towards nadir as it now does toward the stars.

EARL MAYO.



STRANGE VIEWS OF UNDERGROUND NEW YORK LIFE REVEALED